A 20-L Furnace Test Method to Determine the Combustion Gas Toxicity of Conveyor Belts

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Under the U.S. Bureau of Mines, experiments were conducted with mine conveyor belt samples in a 20-L furnace (1 g sample) and in a laboratory fire tunnel (approximately 3,000 g sample) to measure and compare the major toxic gas concentrations evolved during the combustion of the materials (1). The toxic gas concentrations, measured simultaneously through a multi-port sampling device and treated as yield values, included hydrogen chloride (HCl), hydrogen cyanide (HCN), oxides of nitrogen (NO_x treated as NO_2), and carbon monoxide (CO).

The toxic gas yields measured in the 20-L furnace system are in good agreement with similar yields measured in the laboratory fire tunnel system. Thus, either system could be used to obtain the gas yield data for conveyor belts. However, the 20-L furnace system is preferred due to the smaller sample size and less time required to set up and run an experiment. Good and direct correlations were found between the percentage of chlorine, nitrogen and carbon contained in the original materials and the HCl, HCN, NO_2, and CO gas yields. Both experimental systems produced essentially the same results. The greater the percentage of chemical contents, the higher were the corresponding toxic gas yield values.

Results also show that polyvinyl chloride (PVC) belts released higher HCl concentrations because of the higher chlorine content while the styrene-butadiene rubber (SBR) belts released higher CO, HCN, and NO_2 concentrations because of the higher carbon and nitrogen contents.

Using the toxic gas yield data, a toxicity index (TI) parameter was calculated for each belt material. The TI is a measure of the potential gas toxicity that a belt can produce during a fire; the higher the TI value, the greater is the potential toxicity. As expected, the TI was the highest for the PVC belts (1.06 and 1.22 m^3/g for sample P1, using the gas yields measured in the 20-L furnace and fire tunnel, respectively), and the lowest for the SBR belts (0.39 and 0.43 m^3/g for sample S2, using the gas yields measured in the 20-L furnace and fire tunnel, respectively). Also, using the TI values and a ratio of average mass loss burning rates to ventilation airflow rates, a toxicity hazard (TH) parameter was calculated for each belt material. The TH estimates the level of toxic gas hazard produced by a burning belt in a ventilated system. In some cases, the mass loss burning rates may be sufficiently great that a belt with a low TI actually produces a more severe toxic gas hazard than a belt with a much higher TI. For example, using the ratio of mass loss burning rates to ventilation airflow rates measured in the fire tunnel system, the TH value calculated for belt S2, whose TI is 60 pct lower than the TI for belt P1, was higher (6.8) than the TH value calculated for belt P1 (6.1) because of the greater mass loss burning rate of belt S2.

REFERENCE

1. De Rosa, M.I. A 20-L Furnace Test Method to Determine the Combustion Gas Toxicity of Conveyor Belts. DOE RI 9626, 1996, 20 pp.

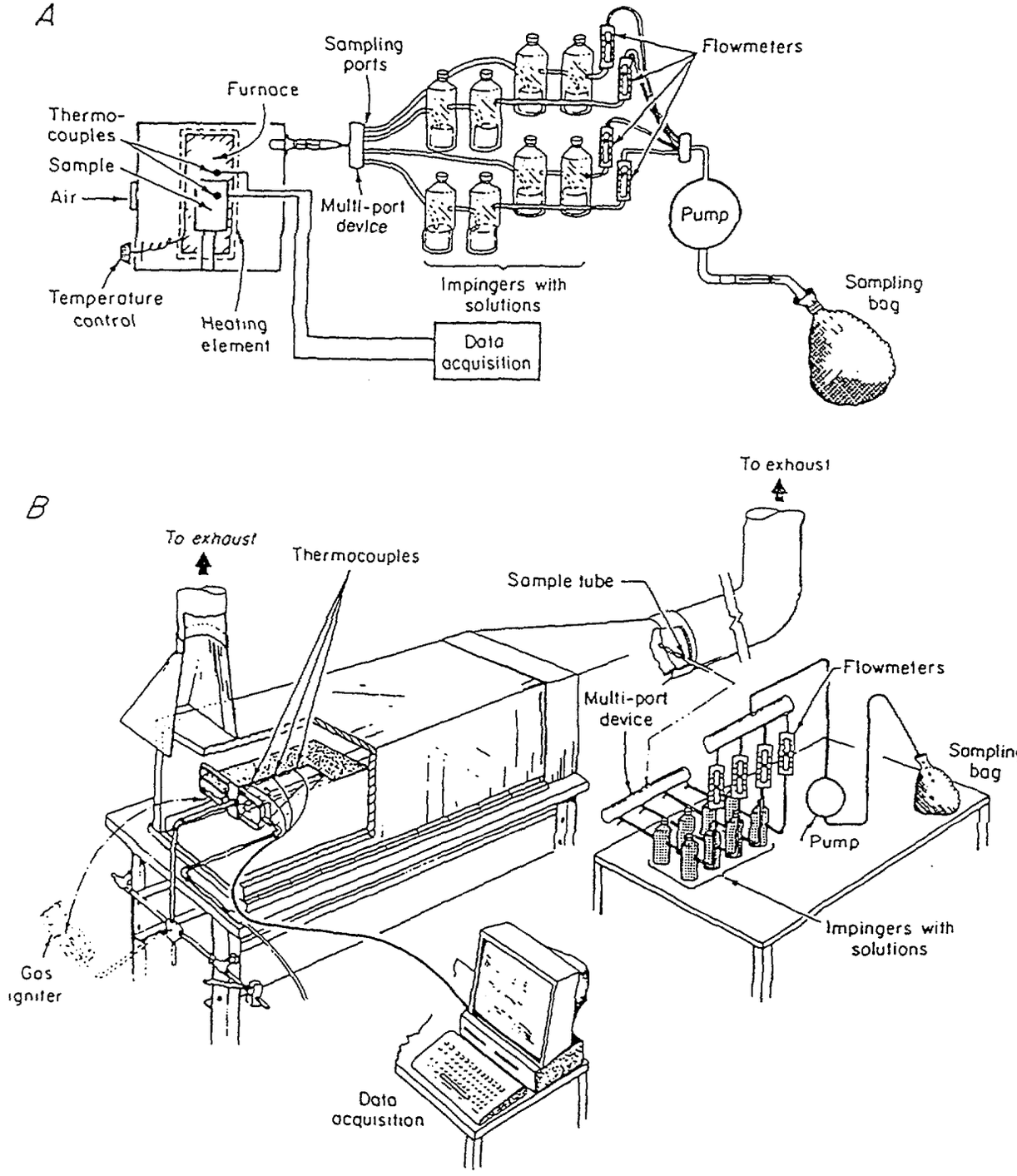

Figure a: 20-L Furnace experimental system.
b: Laboratory fire tunnel experimental system.